

Description

[HEAT SINK STRUCTURE]

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priority benefit of Taiwan application serial no. 92117783, filed June 30, 2003.

BACKGROUND OF INVENTION

[0002] Field of the Invention

[0003] The present invention relates to a heat sink structure, and more particularly to a heat sink structure with a contacting spring.

[0004] Description of the Related Art

[0005] In recent years, extent of integration of internal circuits for integrated circuit (IC) chips has been continuously increased, and, efficiency of heat-dissipating devices used for the IC products has to be enhanced accordingly. Conventionally, a heat sink is designed in direct contact with the surface of the electronic devices, such as central processing unit (CPU), North gate and graphical chips of a

personal computer, so as to provide a relatively large heat-dissipating area to dissipate the heat generated during high-speed operation of IC chips in the electronic devices, and thus keep the IC chips to be operated properly over a long period of high-speed operation. Further, fans are usually installed in the devices to provide cooling air to rapidly absorb heat from the heat sink and release the heat into the ambient air.

[0006] FIG. 1 illustrates a heat sink structure in a conventional chip-packaging unit. The chip-packaging unit 100 is of, for example, a regular ball-grid-array (BGA) type, wherein, the chip 102 is disposed, via flip-chip bonding, on the top surface of, and is electronically connected to the package baseboard 104. In addition, the heat spreader 110 is disposed on the top of the chip-packaging unit 100. The bottom surface 112 of the heat spreader 110 is connected to the back surface of the chip 102 for rapidly absorbing heat generated by the chip 102. Several heat-dissipating fins 140, for example, are disposed vertically on the top surface 114 of the heat spreader 110. The thermal paste 120 adheres between the bottom surface 112 of the heat spreader 110 and the back surface of the chip 102. The thermal paste 120 is, for example, of

thermosetting plastics, so that a strictly controlled procedure has to be followed to heat and solidify the thermosetting plastics and to maintain a proper temperature for ensuring the good contact for the thermal paste 120. However, use of the thermal paste 102 will decrease heat-conducting efficiency especially when a relatively thick thermal paste is used.

[0007] On the other hand, the thermal paste 102 is high in cost and must be treated through complicated heating and solidification processes. Moreover, once the thermal paste 120 is solidified, the heat spreader 110 cannot be disassembled from the chip-packaging unit 100, which is rather inconvenient if a reassembling process is required.

SUMMARY OF INVENTION

[0008] Accordingly, the present invention is directed to provide a heat sink structure, wherein a heat spreader is tightly installed, via a contacting spring, on the top of a chip-packaging unit, such that the packaging process is simplified and, at the mean time, heat-conducting efficiency will be maintained because of high thermal conductivity of the spring.

[0009] In accordance with the above objects, the present invention provides a heat sink structure suitable to be used on

a chip-packaging unit. The heat sink structure includes a heat spreader and at least one arcuate spring. The heat spreader has a top surface and a bottom surface, and the bottom surface covers over the chip-packaging unit. In addition, the arcuate spring is disposed on the bottom surface of the heat spreader, and the end portions of the arcuate spring is connected to two side portions of the bottom surface of the heat spreader. The meddle portion of the arcuate spring is away from the bottom surface of the heat spreader and is suitable to contact with the back surface of the chip-packaging unit.

- [0010] According to preferred embodiments of this invention, the foregoing heat spreader is made of materials, such as aluminum, copper or alloys thereof, and the ends of the arcuate spring are connected to the bottom surface of the heat spreader, for example, through welding, embedding, riveting, or bolting.
- [0011] Since the present invention uses the contacting spring in the heat sink structure, no heating or solidification is required during a fabricating process, and thus the fabricating process is simplified and the productivity can be increased. In addition, since the arcuate spring has good thermal-conductivity and can keep good contact with the

chip-packaging unit, heat-conducting efficiency can be enhanced.

[0012] It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF DRAWINGS

[0013] FIG. 1 is a schematic view of a conventional heat sink structure in a chip-packaging unit.

[0014] FIG. 2 is a schematic view of a heat sink structure in a chip-packaging unit in accordance with a preferred embodiment of the present invention.

[0015] FIG. 3 is a perspective view of a heat sink structure in accordance with another preferred embodiment of the present invention.

DETAILED DESCRIPTION

[0016] FIG. 2 illustrates a heat sink structure in a chip-packaging unit in accordance with a preferred embodiment of the present invention. The heat sink structure 210 is made essentially of a metallic material (e.g., copper, alloy of copper, or alloy of aluminum) having good thermal conductivity, and the heat sink structure consists essentially

of a heat spreader 220 and an arcuate spring 230. In this embodiment, the arcuate spring 230 is used to replace the conventional thermal paste. The arcuate spring 230 does not require heating and solidifying processes, and thus assembling process can be simplified and productivity can be increased. In addition, the chip-packaging unit 200 is of, for example, a regular ball-grid-array (BGA) type, wherein, the chip 202 is disposed, via flip-chip bonding, on the top surface (i.e., the first surface) of the package baseboard 104, and the chip 202 is electronically connected, via a pad (not shown) for example, to the package baseboard 204. Of course, the heat sink structure of this invention is also suitable for other types of chip-packaging units.

- [0017] As shown in FIG. 2, a set of hooks 226 and 228 are fixed on the periphery of the bottom surface 222 of the heat spreader 220. The hooks 226 and 228 are extended downward and clip to the bottom surface (i.e., the second surface) of the package baseboard 204 of the chip-packaging unit 200. The arcuate spring 230 is disposed on the bottom surface 222 of the heat spreader 220, and is formed, for example, along with the heat spreader 220. In a preferred fabricating process, a metal sheet is bent

from two ends into a shape of the arcuate spring 230. The bent metal sheet is then fixed via welding to the bottom surface 222 of the heat spreader 220. Alternatively, the bended metal sheet can be locked or clipped at its two end portions 234, via embedding, onto the side portions, having grooves (not shown) thereon for locking or clipping, of the bottom surface 222 of the heat spreader 220. Further, the bended metal sheet can be also fixed through riveting or bolting at its two ends on the bottom surface 222 of the heat spreader 220. As a result, the end portions 234 of the arcuate spring 230 is fixed on the bottom surface 222 of the heat spreader 220, while the central portion 232 of the arcuate spring 230 is away from the bottom surface 222 of the heat spreader 220 but, on the other hand, is in contact with the back surface of the chip 202 for absorbing rapidly the heat generated form the chip 202. Therefore, the surface of the arcuate spring 230 is in tight contact with the back surface of the chip 202 within a permissible range of elastic deformation of the arcuate spring 230, so that the heat generated on the chip 202 can be conducted through the arcuate spring 230 to the heat spreader 220 and further dissipated from the surface of the heat spreader 220 to the ambient air. In ad-

dition, in order to increase heat-dissipating area of the heat spreader 220, the top surface of the heat spreader 220 can also be designed alternatively in a wavy shape, or several heat-dissipating fins 240 can be disposed perpendicularly on the heat spreader 220.

[0018] FIG. 3 illustrates a heat sink structure in accordance with another preferred embodiment of the present invention. As shown in FIG. 3, the arcuate spring 330 is in a cross shape, wherein the central crossing area 332 is away from the bottom surface 322 of the heat spreader 320 but, on that other hand, is in contact with the surface of the chip of the chip-packaging unit (not shown), while the four end portions 334 of the arcuate spring 330 are respectively fixed onto the four edges (or four corners) on the bottom surface 322 of the heat spreader 320. The connecting methods are the same as mentioned above. Similarly, the surface of the arcuate spring 330 is in tight contact with the back surface of the chip within a permissible range of elastic deformation of the arcuate spring 330, so that the heat generated on the chip can be conducted through the arcuate spring 330 to the heat spreader 320 and further dissipated from the surface of the heat spreader 320 to the ambient air. Of course, three, five, six or even more of

the end portions of the arcuate spring 330 can be designed to be fixed in a radial distribution on the periphery of the bottom surface of the heat spreader, so as to increase the contact area between the arcuate spring and the heat spreader and consequently, to enhance heat-conducting efficiency.

[0019] As known from the above, the heat sink structure includes at least one arcuate spring that is in contact with a surface of the chip-packaging unit, while the heat spreader is not required to be adhered through a thermal paste and thus can be easily assembled on the chip-packaging unit, so as to simplify the assembling process and increase productivity. In addition, since the arcuate spring is made of metal for example, the thermal conductivity of the arcuate spring is higher than that of the conventional thermal paste. Under a work condition of high pressure and high humidity, especially, the conventional thermal paste will be operated in a decreased heat-conducting efficiency, but the arcuate spring can still maintain its good heat-conducting efficiency. On the other hand, the conventional thermal paste will become aged over time, while the arcuate spring is more durable against the change and thus has longer lifetime. When the arcuate spring is used, moreover, the

heat sink structure can be disassembled, if required, from the chip-packaging unit.

- [0020] Accordingly, the heat sink structure of this invention has the following advantages:
- [0021] (1) In an assembling process, the heat spreader is not required to be fixed by using thermal paste, and thus rather complicated heating and solidification processes are no longer needed, which makes the assembling process simple and handy.
- [0022] (2) Since the arcuate spring is used for contact, the heat spreader can be tightly disposed on the chip-packaging unit, which can enhance the heat-conducting efficiency due to good thermal conductivity of the arcuate spring.
- [0023] (3) The heat sink structure and the chip-packaging unit are locked together through a locking mechanism (e.g., a hook), and thus the arcuate spring can be conveniently disassembled from the chip-packaging unit.
- [0024] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention covers modifications and variations of this invention provided they fall within

the scope of the following claims and their equivalents.